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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
GENACK, MATTHEW W	
ART UNIT	**PAPER NUMBER**
2617	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/20/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	09/922,442	LIANG ET AL.	
	Examiner	Art Unit	
	Matthew W. Genack	2617	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 January 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12,14,15 and 17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12,14,15 and 17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1 and 7 are rejected under 35 U.S.C. 102(e) as being anticipated by Dogan *et. al.,* U.S. Patent No. 6,018,317.

Dogan *et. al.* discloses a method for generating transmit beamformer weight vectors (that is, downlink beamformer weight vectors) for use by a base station antenna array in communications with multiple user stations (Abstract, Column 23 Lines 60-65, Fig. 5), whereby the uplink signals and downlink signals are at separate frequencies (Column 23 Lines 42-51). The combination of received uplink signals are used to compute uplink beamforming weight vectors for each user station (Column 4 Lines 24-35, Column 22 Lines 20-34, Column 58 Lines 1-30, Figs. 1-3 and 30). The directivity pattern, wherein every angle has a gain (thus determining the nulls and the main beam location) and phase associated with it, of each signal is recovered from the uplink beamforming weight vector (Column 10 Line 22 to Column 11 Line 14, Column 50 Lines 8-22, Column 53 Lines 28-35). Receive nulls (that is, uplink nulls) are used to create transmit nulls (that is, downlink nulls) (Column 63 Line 63 to Column 64 Line 3). A transmit weight vector (that is, a downlink weight vector) is

generated based on the directivity pattern (which includes the nulls); the downlink beamforming weight vectors are used to modify an information signal, which is then sent to the array to be transmitted (Column 32 Lines 32-59, Column 73 Line 58 to Column 74 Line 4).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 2 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dogan *et. al.* in view of Bakhru, U.S. Patent No. 4,173,759, further in view of Dent, U.S. Patent No. 5,555,257.

Regarding Claim 2, Dogan *et. al.* does not expressly disclose the categorization of uplink nulls into good uplink nulls and bad uplink nulls, nor the reassignment of said bad uplink nulls in such a way as to form corrected uplink nulls, nor the practice of scaling the phases of antenna patterns according to a factor that is related to the ratio of the downlink operating frequency and the uplink operating frequency.

Bakhru teaches that a problem encountered with certain antenna arrays is the existence of a null in the exact direction that an information signal is being received (thus, an uplink signal) from, and that the disclosed invention remedies this problem (Column 1 Lines 39-46). In the disclosed invention, the antenna

array's receiving pattern is steered so that the nulls are not in the direction of the desired information signal, but rather in the direction of sources of interference, and the main lobes are in the direction of the desired information signals (Column 2 Lines 31-41).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan et. *al.* by identifying unwanted uplink nulls that are in the direction of desired information signals and moving said unwanted nulls to other directions (preferably in the direction of interfering signals).

One of ordinary skill in the art would have been motivated to make this modification because such a categorization and movement of unwanted uplink nulls is useful for reducing uplink interference and consequently allowing for higher uplink data rates.

Neither Dogan *et. al.* nor Bakhru discloses the practice of scaling the phases of antenna patterns according to a factor that is related to the ratio of the downlink operating frequency to the uplink operating frequency.

Dent discloses the practice of scaling the relative phases of antenna array element signals according to a factor that is related to the ratio of the uplink wavelength to the downlink wavelength (wavelength being inversely proportional to frequency) (Column 30 Lines 50-56) in the context of cellular/satellite communication systems (Abstract).

At the time that the invention was made, it would have been obvious to one of

ordinary skill in the art to modify the invention of Dogan *et. al.* as modified by Bakhru by scaling the phases of wanted uplink nulls and corrected (shifted) unwanted uplink nulls according to a factor that is related to the ratio of the downlink operating frequency and the uplink operating frequency.

One of ordinary skill in the art would have been motivated to make this modification because it allows the optimization of system performance according to whatever uplink and downlink frequencies are being used, and thereby provides flexibility.,

Regarding Claim 6, it was mentioned above, in the rejection of Claim 2, that Bakhru discloses that the antenna array's receiving pattern is steered so that the nulls are not in the direction of the desired information signal, but rather in the direction of sources of interference, and the main lobes are in the direction of the desired information signals.

5. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dogan *et. al.* in view of Bakhru, further in view of Dent, further in view of Toda, U.S. Patent No. 6,411,015.

Neither Dogan *et. al.*, nor Bakhru, nor Dent discloses an antenna pattern minimum angle condition whereby said minimum angle is equal to the arcsine of an argument involving the ratio of a downlink wavelength to an element spacing.

Toda discloses a multiple piezoelectric transducer array (Abstract, Column 1 Line 66 to Column 2 Line 15). Toda discloses an electromagnetic pattern array condition for the angle between the main lobe and a side lobe, whereby θ =

arcsin(λ/P), where θ is the aforementioned angle, λ is the wavelength, and P is the spacing between elements of the array (Column 5 Lines 5-22, Fig. 7).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan et. al. as modified by Bakhru, further modified by Dent by categorizing an uplink null as bad if it satisfies the condition of being greater than an angle $\theta = \arcsin((\lambda_d/Z) - 1)$, whereby λ_d is the downlink wavelength and Z is the antenna array element spacing, and its corresponding pseudo-null in the downlink pattern lies within a specified proximity of the main beam position.

One of ordinary skill in the art would have been motivated to make this modification because it provides a precise means of determining whether or not a given uplink null is capable of hindering the performance of a communication system.

6. Claims 4-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dogan *et. al.* in view of Bakhru, further in view of Dent, further in view of Shafai, U.S. Patent No. 4,947,178.

Neither Dogan *et. al.*, nor Bakhru, nor Dent expressly discloses the step of resetting an unwanted null to 0 degrees or to anywhere within an interval of directions centered on 0 degrees.

Shafai discloses a novel scanning array antenna (Abstract, Column 1 Lines 60-66). When this antenna moves from the n = 1 mode to higher order modes, a null is placed along the θ = 0 degrees direction, where this was formerly a radiation

peak for the n = 1 mode (Column 3 Lines 33-47, Figs. 1-2).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan *et.* al. as modified by Bakhru, further modified by Dent by providing a step whereby unwanted nulls in the antenna array radiation pattern are set to the $\theta = 0$ degrees direction (which is in the interval [-X,X] for any real number X).

One of ordinary skill in the art would have been motivated to make this modification because the step whereby an unwanted null is moved helps to reduce interference, and thereby allows higher data rates in the communication system.

7. Claims 8 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dogan *et. al.* in view of Castellon *et. al.,* U.S. Patent No. 5,714,932.

Regarding Claim 8, Dogan *et. al.* does not expressly state the separation between the elements of the array of the disclosed invention.

Castellon *et. al.* discloses an antenna array, the elements of which are less than or equal to one half of the RF carrier wavelength (Column 14 Lines 43-55, Fig. 1).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan. *et.* al. by explicitly specifying element separations of less than or equal to one half of the downlink wavelength.

One of ordinary skill in the art would have been motivated to make this modification because it would help prevent unwanted nulls being in directions

whereby the levels of power received by terminals in those directions are severely reduced.

Regarding Claim 10, one quarter of the sum of the downlink wavelength and uplink wavelength is equal to the average value of one half of the downlink wavelength and one half of the uplink wavelength. Castellon et. *al.* discloses an antenna array, the elements of which may be equal to one half of the RF carrier wavelength (Column 14 Lines 43-55, Fig. 1).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan *et. al.* by explicitly specifying element separations equal to one quarter the sum of the downlink wavelength and the uplink wavelength.

One of ordinary skill in the art would have been motivated to make this modification as a way to attain an antenna array element spacing value that is approximately (due to the fact that the uplink frequency and the downlink frequency are usually relatively close) one half wavelength for both the uplink and the downlink, and thereby enjoy the null correcting advantages associated with one half wavelength array element spacing for both the uplink and the downlink.

8. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dogan *et. al.* in view of Castellon *et. al.*, further in view of Bryanos, U.S. Patent No. 5,349,364.

Dogan *et. al.* does not expressly state the separation between the elements of the array of the disclosed invention.

Castellon *et. al.* discloses an antenna array, the elements of which are less than or equal to one half of the RF carrier wavelength (Column 14 Lines 43-55, Fig. 1).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan et. *al.* by explicitly specifying element separations of less than or equal to one half of the uplink wavelength.

One of ordinary skill in the art would have been motivated to make this modification because it would help prevent unwanted nulls being in directions whereby the levels of power received by terminals in those directions are severely reduced.

Neither Dogan *et. al.* nor Castellon *et. al.* expressly discloses separation between array elements greater than half of the carrier wavelength.

Bryanos *et. al.* teaches the use of an antenna array that provides beam scanning that has elements separated by more than one half of wavelength (Column 1 Lines 18-42).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan *et. al.* as modified Castellon *et. al.* by explicitly specifying element separations of greater than one half of the downlink wavelength.

One of ordinary skill in the art would have been motivated to make this modification because it would help prevent unwanted nulls being in directions whereby

the levels of power received from and by terminals in those directions are severely reduced.

9. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dogan *et. al.* in view of Dent, further in view of Bakhru, further in view of Kasami *et. al.* U.S. Patent No. 6,400,318.

Dogan *et. al.* discloses a method for generating transmit beamformer weight vectors (that is, downlink beamformer weight vectors) for use by a base station antenna array in communications with multiple user stations (Abstract, Column 23 Lines 60-65, Fig. 5), whereby the uplink signals and downlink signals are at separate frequencies (Column 23 Lines 42-51). The combination of received uplink signals are used to compute uplink beamforming weight vectors for each user station (Column 4 Lines 24-35, Column 22 Lines 20-34, Column 58 Lines 1-30, Figs. 1-3 and 30). The directivity pattern, wherein every angle has a gain (thus determining the nulls and the main beam location) and phase associated with it, of each signal is recovered from the uplink beamforming weight vector (Column 10 Line 22 to Column 11 Line 14, Column 50 Lines 8-22, Column 53 Lines 28-35). Receive nulls (that is, uplink nulls) are used to create transmit nulls (that is, downlink nulls) (Column 63 Line 63 to Column 64 Line 3). A transmit weight vector (that is, a downlink weight vector) is generated based on the directivity pattern (which includes the nulls); the downlink beamforming weight vectors are used to modify an information signal, which is then sent to the array to be transmitted (Column 32 Lines 32-59, Column 73 Line 58 to Column 74 Line 4).

Dogan *et. al.* does not expressly disclose the division of a communication cell into a plurality of sectors and the identification of uplink nulls that may yield a pseudo-null in a given sector.

Dent teaches the practice of illuminating a cell from its geographic center, and dividing said cell into three 120 degree sectors (Column 1 Line 58 to Column 2 Line 10).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan et. al. by dividing the communication cell served by the antenna array into a plurality of sectors.

One of ordinary skill in the art would have been motivated to make this modification because it would help reduce interference and increase frequency re-use.

Neither Dogan *et. al.* nor Dent expressly discloses the identification of unwanted uplink nulls.

Bakhru teaches that a problem encountered with certain antenna arrays is the existence of a null in the exact direction that an information signal is being received (thus, an uplink signal), from and that the disclosed invention remedies this problem (Column 1 Lines 39-46).

At the time that the invention was made, it would have been obvious to modify the invention of Dogan et. *al.* as modified by Dent by providing for the identification of uplink nulls that may degrade performance in a given sector.

One of ordinary skill in the art would have been motivated to make this modification because it would help reduce interference and thereby improve uplink data rates.

Neither Dogan *et. al.*, nor Dent, nor Bakhru expressly discloses the use of the null constrain method in the context of antenna arrays.

Kasami *et. al.* discloses an base station adaptive antenna array that uses the null constraint method (Abstract, Column 28 Line 30 to Column 29 Line 6, Column 29 Line).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan et. *al.* as modified by Dent as modified by Bakhru by providing for the use of the null constraint method by the base station.

One of ordinary skill in the art would have been motivated to make this modification in order to allow a base station to prepare a radiation pattern that minimizes interference (Kasami *et. al.*: Column 29 Line 52 to Column 30 Line 12).

10. Claims 12 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dogan *et. al.* in view of Boros *et. al.,* U.S. Patent No. 6,615,024.

Dogan *et. al.* discloses a method for generating transmit beamformer weight vectors (that is, downlink beamformer weight vectors) for use by a base station antenna array in communications with multiple user stations (Abstract, Column 23

Lines 60-65, Fig. 5), whereby the uplink signals and downlink signals are at separate frequencies (Column 23 Lines 42-51). The combination of received uplink signals are used to compute uplink beamforming weight vectors for each user station (Column 4 Lines 24-35, Column 22 Lines 20-34, Column 58 Lines 1-30, Figs. 1-3 and 30). The directivity pattern, wherein every angle has a gain (thus determining the nulls and the main beam location) and phase associated with it, of each signal is recovered from the uplink beamforming weight vector (Column 10' Line 22 to Column 11 Line 14, Column 50 Lines 8-22, Column 53 Lines 28-35). Receive nulls (that is, uplink nulls) are used to create transmit nulls (that is, downlink nulls) (Column 63 Line 63 to Column 64 Line 3). A transmit weight vector (that is, a downlink weight vector) is generated based on the directivity pattern (which includes the nulls); the downlink beamforming weight vectors are used to modify an information signal, which is then sent to the array to be transmitted (Column 32 Lines 32-59, Column 73 Line 58 to Column 74 Line 4).

Dogan *et. al.* does not expressly disclose the presence of a downlink weight generator in the base station, nor the means to move downlink nulls to a safe position.

Boros *et. al.,* U.S. Patent No. 6,615,024 discloses a transmit weight generator for generating downlink weights based on differences between the phases and gains of the uplink and downlink signal paths, and the means to place nulls in positions so as to minimize interference to co-channel users (Column 13 Lines 19-49).

At the time that the invention was made, it would have been obvious to one of

ordinary skill in the art to modify the invention of Dogan *et. al.* by incorporating a downlink weight generator in the base station that generates downlink weights based on a signal's characteristics, and giving said base station the means to move downlink nulls to a safe position.

One of ordinary skill in the art would have been motivated to make this modification so that a high number of users in close proximity can use the wireless communication system.

11. Claims 14 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dogan *et. al.* in view of Boros *et. al.*, further in view of Dent, further in view of Kasami *et. al.*

Further in view of the rejection of Claim 12, which is nearly identical to Claim 14, Dent teaches the practice of illuminating a cell from its geographic center, and dividing said cell into three 120 degree sectors (Column 1 Line 58 to Column 2 Line 10).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan *et. al.* as modified by Boros *et. al.* by dividing the communication cell served by the antenna array into a plurality of sectors.

One of ordinary skill in the art would have been motivated to make this modification because it would help reduce interference and increase frequency re-use.

Neither Dogan *et. al.*, nor Boros *et. al.*, nor Dent expressly discloses the use of the null constrain method in the context of antenna arrays.

Kasami *et. al.* discloses an base station adaptive antenna array that uses the null constraint method (Abstract, Column 28 Line 30 to Column 29 Line 6, Column 29 Line).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Dogan et. *al.* as modified by Boros *et. al.* as modified by Dent by providing for the use of the null constraint method by the base station.

One of ordinary skill in the art would have been motivated to make this modification in order to allow a base station to prepare a radiation pattern that minimizes interference (Kasami *et. al.*: Column 29 Line 52 to Column 30 Line 12).

Response to Arguments

12. Applicant's arguments filed 8 January 2007 have been fully considered but they are not persuasive.

Applicant asserts, on Page 6 of Remarks, that "Dogan does not disclose the steps of: identifying uplink nulls and an uplink main beam position from said uplink beamforming weight vector, transforming each of said uplink nulls to form a corresponding downlink null, and generating a downlink beamforming weight vector from all downlink nulls." Applicant proceeds to make general comparisons between the specification of the invention and the disclosure of Dogan *et. al.* Applicant has failed to

traverse the mapping, in the 35 U.S.C. 102(e) rejection, between the cited locations in Dogan *et. al.* and the three elements in the above quote.

13. Applicant's arguments with respect to Claims 11 and 14 have been considered but are moot in view of the new grounds of rejection necessitated by Applicant's amendment filed 8 January 2007.

Conclusion

14. Applicant's amendment necessitated the new grounds of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew W. Genack whose telephone number is 571-272-7541. The examiner can normally be reached on Flex.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Duc Nguyen can be reached on 571-272-7503. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew Genack

Examiner

TC-2600, Division 2617

Matthew Genack

3 April 2007

Nguyen

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